

Student Information

Full Name: Ozan Akin

Id Number: 2309599

Answer 1

a)

p	q	$\neg p$	$q \rightarrow \neg p$	$p \leftrightarrow q$	$(q \rightarrow \neg p) \leftrightarrow (p \leftrightarrow q)$
F	F	T	T	T	T
F	T	T	T	F	F
T	F	F	T	F	F
T	T	F	F	T	F

b)

p	q	r	$p \vee q$	$p \rightarrow r$	$q \rightarrow r$	$(p \vee q) \wedge (p \rightarrow r)$
F	F	F	F	T	T	F
F	F	T	F	T	T	F
F	T	F	T	T	F	T
F	T	T	T	T	T	T
T	F	F	T	F	T	F
T	F	T	T	T	T	T
T	T	F	T	F	F	F
T	T	T	T	T	T	T

$(p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)$	$((p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)) \rightarrow r$
F	T
F	T
F	T
T	T
F	T
T	T
F	T
T	T

Answer 2

$\neg p \rightarrow (q \rightarrow r)$	\equiv	$\neg(\neg p) \vee (q \rightarrow r)$	Table 7 first equivalence
	\equiv	$p \vee (q \rightarrow r)$	Table 6 double negation law
	\equiv	$p \vee (\neg q \vee r)$	Table 7 first equivalence
	\equiv	$(\neg q \vee r) \vee p$	Table 6 commutative laws
	\equiv	$\neg q \vee (r \vee p)$	Table 6 associative laws
	\equiv	$\neg q \vee (p \vee r)$	Table 6 commutative laws
	\equiv	$\neg(\neg q) \rightarrow (p \vee r)$	Table 7 first equivalence
	\equiv	$q \rightarrow (p \vee r)$	Table 6 double negation law

Answer 3

- a) $\forall x(L(x, Burak))$
- b) $\forall y(L(Hazal, y))$
- c) $\forall x \exists y(L(x, y))$
- d) $\neg \exists x \forall y(L(x, y))$
- e) $\forall y \exists x(L(x, y))$
- f) $\neg \exists x(L(x, Burak) \vee L(x, Mustafa))$
- g) $\exists x \exists y(L(Ceren, x) \wedge L(Ceren, y) \wedge \forall z(L(Ceren, z) \rightarrow (z = x \vee z = y)))$
- h) $\exists y \forall x(L(x, y) \wedge \forall z(L(x, z) \rightarrow y = z))$
- i) $\neg \exists x(L(x, x))$
- j) $\exists x \exists y(L(x, y) \wedge (x \neq y) \wedge \forall z(L(x, z) \rightarrow \forall z(z = y)))$

Answer 4

$p, p \rightarrow (r \rightarrow q), q \rightarrow s \vdash \neg q \rightarrow (s \vee \neg r)$		
1.	p	<i>premise</i>
2.	$p \rightarrow (r \rightarrow q)$	<i>premise</i>
3.	$r \rightarrow q$	$\rightarrow e, 1, 2$
4.	$\neg q$	<i>assumption</i>
5.	r	<i>assumption</i>
6.	q	$\rightarrow e, 3, 5$
7.	\perp	$\neg e, 4, 6$
8.	$\neg r$	$\neg i, 5 - 7$
9.	$s \vee \neg r$	$\vee i, 8$
10.	$\neg q \rightarrow (s \vee \neg r)$	$\rightarrow i, 4 - 9$

Answer 5

$\forall x(p(x) \rightarrow q(x)), \neg \exists z r(z), \exists y p(y) \vee r(a) \vdash \exists z q(z)$		
1.	$\neg \exists z r(z)$	<i>premise</i>
2.	$r(a)$	<i>assumption</i>
3.	$\exists z r(z)$	$\exists i, 2$
4.	\perp	$\neg e, 1, 3$
5.	$\neg r(a)$	$\neg i, 2 - 4$
6.	$\exists y p(y) \vee r(a)$	<i>premise</i>
7.	$\exists y p(y)$	$\vee e, 5, 6$
8.	z $p(z)$	$\exists e, 7$
9.	$\forall x(p(x) \rightarrow q(x))$	<i>premise</i>
10.	z $p(z) \rightarrow q(z)$	$\forall e, 9$
11.	$q(z)$	$\rightarrow e, 8, 10$
12.	$\exists z q(z)$	$\exists i, 11$